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A SELECTED AND ANNOTATED BIBLIOGRAPHY OF STUDIES CONCERNING THE TAXONOMY OF EDUCATIONAL OBJECTIVES--COGNITIVE DOMAIN.

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THE AUTHORS HAVE COMPILED AN ANNOTATED LIST OF 61 REPORTS OF STUDIES AND OTHER DOCUMENTS CONCERNING THE USE OF THE TAXONOMY AT VARIOUS LEVELS OF EDUCATION. (WO)

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A SELECTED AND ANNOTATED BIBLIOGRAPHY OF STUDIES CONCERNING THE TAXONOMY OF EDUCATIONAL OBJECTIVES: COGNITIVE DOMAIN

RICHARD C. COX AND NANCY JORDAN UNKS

JC 670917

A Selected and Annotated Bibliography of Studies Concerning the Taxonomy of Educational Objectives: Cognitive Domain

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and

Nancy Jordan Unks

Learning Research and Development Center

University of Pittsburgh

June, 1967

PREFACE

On February 9, 1965, the day preceding the annual meetings of the American Educational Research Association, a small group of individuals met for the purpose of discussing various research activities pertaining to the Taxonomy of Educational Objectives Handbook 1: Cognitive Domain. The participants in this meeting, chaired by David Krathwohl, included the authors of the Taxonomy and approximately fifteen scholars who had either utilized the Taxonomy in their work or had conducted research on the Taxonomy. There was unanimous agreement at the meeting that there existed a definite need for some communication channel among persons working with the Taxonomy.

As a first step toward meeting this need, John M. Gordon and myself started to systematically search for publications and unpublished reports in order to compile a list of references for dissemination to interested researchers. As this task proceeded it seemed logical to provide a short description of each report so that a prospective user could decide whether or not the reported study would be relevant for his purposes. The result of the first effort at information retrieval was two documents: "Validation and Uses of the Taxonomy of Educational Objectives: Cognitive Domain, A Select and Annotated Bibliography" and "In-Progress Studies and Utilization of the Taxonomy." Both of these documents were mimeographed reports and were disseminated during the month of February, 1966. The documents were sent to all persons contributing references, to the participants of the 1965 meeting, and in answer to any individual requests received during 1966. The response to this first effort was extremely rewarding both in terms of the number of requests and the favorable unsolicited comments.

Another meeting of the Taxonomy group was held during the February, 1966, AERA session. At this time it was heartily recommended that the bibliographies be kept up to date. In December, 1966, addenda to the original two documents were prepared and disseminated. These included the studies and in-progress reports that had come to my attention since the original documents were compiled. This year, with the help of Nancy Jordan Unks, a graduate student in Educational Research at the University of Pittsburgh School of Education, the collection and abstraction processes have continued.

A few months ago, Nancy Unks and I decided to update some of the earlier references and to prepare one annotated bibliography which would include both studies cited previously and recent acquisitions for which exact bibliographic information is available. The result of this effort is this present document. In-progress studies and notes of information concerning the use of the Taxonomy are not included.

This bibliography is not complete since we were unable to obtain copies of some of the references and thus could not prepare abstracts. We are also missing addresses of some of the authors. We would appreciate any information that readers might supply to help complete the bibliography. Our sincere hope is that this document will be of value to researchers in professional endeavors concerning work with the cognitive domain of the Taxonomy.

Richard C. Cox
May, 1967

ANNOTATED BIBLIOGRAPHY

Acme Film Laboratories, Inc.
Series of six films on the Taxonomy. Mary P. Broderick, Education Research Consultant.
Title: Development of Scientific Discovery Methodology, and Investigation through a Study of Graphic Representation of Statistical Information. (Application of the Taxonomy to the study of mathematics).

Reel no. 1. Knowledge
2. Comprehension
3. Application
4. Analysis
5. Synthesis
6. Evaluation

Address: Acme Film Laboratories, Inc.
1161 North Highland Avenue
Hollywood, California 90038

Allen, Graham. The development of tests for the measurement of cognitive objectives in social studies at the upper primary level. Unpublished masters thesis, University of Melbourne, 1966.

The Taxonomy was used to classify "unique" objectives of Social Studies. Tests were then designed to measure these objectives and an attempt was made to use correlational techniques, including factor analysis, to establish some of the properties claimed for the Taxonomy. It was found that sub-tests of items from the same test correlated more highly and were more alike in factor structure than sub-tests of items from different tests which had the same taxonomical classification. Thus the hierarchical structure of the Taxonomy was neither supported nor denied. It was concluded that correlational techniques are not appropriate to the task.

Address: Graham Allen
Coburg Teachers College
Coburg, Victoria, Australia

Ayers, J. Douglas. Justification of Bloom's Taxonomy by factor analysis. Paper read at the annual meeting of the American Educational Research Association, Chicago, February, 1966.

Factor analyses were conducted on a 40 item multiple choice test. The items were classified according to the Taxonomy in order to provide a criterion for rotation of factors and to justify the classification. The hierarchical structure of the Taxonomy was supported. The study suggests the analyses of longer tests which utilize more of the Taxonomy categories.

Address: J. Douglas Ayers
California Test Bureau
Del Monte Research Park
Monterey, California 93940

Ayers, J. Douglas, et. al. Summary description of grade nine science objectives and test items. Prepared at the direction of the High School Entrance Examinations Board, Department of Education Edmonton, Alberta, March 1965.

The blueprint for a grade nine science examination was developed indicating the intended proportion of items falling in each category of the Taxonomy. A description of some objectives and test items for all six Taxonomy categories is provided.

Address: Same as above.

Ayers, J. Douglas, et. al. Summary description of grade nine social studies objectives and test items, 1st. edition. The High School Entrance Examinations Board, Department of Education, Edmonton, Alberta, 1966.

This pamphlet is a guide for ninth grade Social Studies teachers and describes the classification of Social Studies objectives and test items according to the Taxonomy. It is intended to help bring consistency between objectives and testing in Jr. High School Social Studies. Examples of objectives and test items classified in each of major areas (as well as some subcategories) are presented.

Address: Same as above.

Baughman, Gerald D., & Mayrhofer, Albert. Leadership training project: a final report. Journal of Secondary Education, 1965, 40, No. 8, 369-372.

During the first four meetings of the Leadership Training Project, twenty-five people in positions of active responsibility for curriculum design, construction and evaluation studied and discussed the Taxonomy. The next four meetings were conducted by speakers who discussed the implications of the Taxonomy for education. Subsequent meetings included a curriculum theorist's view on the Taxonomy, a discussion of student typologies, curriculum and guidance in reference to the Taxonomy. During the first and last meetings the participants were asked to list objectives for K-6 science program. Of the 64 objectives suggested in the first meeting only 41 (64%) could be classified according to the Taxonomy categories. In the final meeting the same participants listed 306 objectives with 256 (84%) classifiable according to the Taxonomy. The following breakdown of objectives is presented.

Taxonomy Level	41 Objectives Before Training		256 Objectives After Training	
Level I -- Knowledge	20	48.8%	51	19.9%
Level II -- Comprehension	17	41.5%	54	21.1%
Level III -- Application	0	0.0%	16	6.3%
Level IV -- Analysis	2	4.9%	57	22.3%
Level V -- Synthesis	1	2.4%	48	18.7%
Level VI -- Evaluation	1	2.4%	30	11.7%
TOTALS	41	100.0%	256	100.0%

Address: Gerald D. Baughman
507 East 18th Street
San Bernardino, California 92004

Address: Albert Mayrhofer
Coordinator of Instructional Materials
San Mateo Union High School District
San Mateo, California 94401

Carroll, Charles Robert. Application of the "Taxonomy of Educational Objectives" to alcohol education. Unpublished doctoral dissertation, Ohio State University, 1965.

Objectives of alcohol education were classified according to the Taxonomy. The appropriateness of the objectives for general education was then judged by ten alcohol education specialists and ten school health educators. The two groups of judges agreed 68% on the acceptance or rejection of each objective, but disagreed about their degree of importance. This may have been because of judges' individual values and different interpretations of the Taxonomy, general education, and the importance of alcohol education. It was concluded that the Taxonomy can be a useful logical schema for organizing alcohol education.

Address: Unknown.

Cox, Richard C. Item selection techniques and evaluation of instructional objectives. Journal of Educational Measurement, 1965, 2, (2), 181-187.

An item pool of 379 multiple-choice items was classified using the Taxonomy categories. From this item pool the 100 most discriminating items were examined in order to determine the effect that statistical item selection has on the final form of a test as compared with the original item pool. Findings indicate that statistical selection of items has a biasing effect on tests in terms of percentage of items in each Taxonomy category. The proportion of items in the selected tests (100 items) which measure certain instructional objectives is unlike the proportion of items in the total item pool. Statistical selection of items from the total item pool appears to operate differentially for male and female groups.

Address: Richard C. Cox
160 North Craig Street
Learning Research and Development Center
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Pittsburgh, Pennsylvania 15213

Cox, Richard C. An overview of studies involving the "Taxonomy of Educational Objectives: Cognitive Domain" during its first decade. Paper presented at the annual meeting of the American Educational Research Association, Chicago, Illinois, February, 1966.

The impact of the Taxonomy is assessed with reference to four criteria. In order to be considered a useful and effective tool, the Taxonomy must be (1) communicable, (2) comprehensive, (3) stimulating to thought concerning educational problems, and (4) acceptable and useful to workers in the field. Studies are cited which exemplify how well the Taxonomy meets each of these criteria. Considerable discussion is devoted to educational problems brought to light by the Taxonomy. As a whole the Taxonomy appears to meet all 4 criteria successfully.

Address: Same as page before.

Davis, O. L. Jr. & Hunkins, Francis P. Textbook questions: what thinking processes do they foster? Peabody Journal of Education, March 1966, 43:285-292.

(Abstract to be included at a later date.)

Address: O. L. Davis, Jr.
Associate Professor
Department of Curriculum and Instruction
College of Education
The University of Texas
Austin, Texas 78712

Address: Francis Hunkins
Assistant Professor
College of Education
University of Washington
Seattle, Washington 98105

Dressel, Paul & Nelson, C. Questions and problems in science. Test Folio No. 1. Cooperative Test Division, Educational Testing Service, Princeton, New Jersey, 1956.

Examinations submitted by science teachers were separated according to their relevance for the biological and physical sciences. The items in each test were then classified using the subcategories. of the Taxonomy, in order to provide a test bank of science items.

Address: Paul Dressel
Director
Institutional Research
Michigan State University
East Lansing, Michigan 48823

Address: Clarence Nelson
Office of Evaluation Services
Michigan State University
East Lansing, Michigan 48823

Elliott, C. B., Merrifield, Philip R., & Davis, O. L. Jr. Cognitive dimensions of lesson objectives set by secondary student teachers. Paper read at the annual meeting of the American Educational Research Association, Chicago, February, 1966.

ALSO

Elliott, C. B. Cognitive dimensions of lesson objectives set by secondary student teachers. Unpublished masters thesis, Kent State University, 1965.

This study investigates the feasibility of developing a procedure enabling educators to utilize the Taxonomy in evaluating lesson plan objectives. The study explores (a) using the Taxonomy to analyze the lesson objectives of student teachers; (b) using judges to independently catagorize these objectives according to a prescribed graphic scaling format based on the Taxonomy; and (c) determining which of two such formats was most practicable. Correlational analyses of data failed to support the hypothesized inter-rater agreement and reliability.

(cont'd on next page)

The data also failed to support the hypothesis that the level of raters prior knowledge of the use of the Taxonomy makes a difference.

Address: Clifford B. Elliot
Principal
Hamilton Local School
Columbus, Ohio 43207

Address: Philip R. Merrifield
Director
Bureau of Educational Research
Kent State University
Kent, Ohio 44240

Address: O. L. Davis, Jr.
Associate Professor
Department of Curriculum and Instruction
College of Education
The University of Texas
Austin, Texas 78712

Ellis, John Kenneth. The application of the "Taxonomy of Educational Objectives" to the determination of objectives for health teaching. Unpublished doctoral dissertation, University of Michigan, 1963.

The Taxonomy was utilized to identify different levels of thinking in relation to specific health content and to help select objectives and content for health teaching. The Taxonomy was the framework used to generate 354 objectives. Major conclusion regarding the Taxonomy purports that the categories are applicable to the field of health education in helping to define substantive content and objectives.

Address: Unknown

Gagné, Robert M. _____. Paper presented at the National Symposium on Research in Programmed Instruction, Washington, D. C., 1963.

The Taxonomy is suggested as a guide for curriculum construction. The Taxonomy can be useful at the more abstract levels of curriculum construction but a more specific model is required to guide the selection of instructional materials. A reformulation of the objectives using test items as a basis would help in the development of a specific model.

Address: Robert M. Gagné, Professor
University of California
Berkeley, California 94305

Hanney, Leo F., Principal Research Officer (Examinations). School certificate examinations. Department of Education, New South Wales, Australia, 1966.

The Examinations Committees of the New South Wales Department of Education, Sydney, Australia have used the Taxonomy in constructing School Certificate Examinations. The Taxonomy provides a guide to the classification of objectives and to suggested techniques of examining those objectives. Reports on the tests to the schools also use the Taxonomy as a model. Use of the Taxonomy has been primarily in the construction of science tests.

Address: Leo F. Hanney
Examinations Research Officer
Education Department
New South Wales, Australia

Hunkins, Francis P. The influence of analysis and evaluation questions on critical thinking and achievement in sixth grade social studies. Unpublished doctoral dissertation, Kent State University, 1966.

This study attempts (a) to determine if the dominant use of analysis and evaluation (Taxonomy categories) questions in social studies text-type materials would stimulate the development of pupils' critical thinking in sixth grade social studies; and (b) to discover if this emphasis would improve achievement in social studies. Major conclusions of the study relevant to the Taxonomy are as follows: (1) There were no significant differences in the critical thinking abilities among pupils using materials with question emphasis on analysis and evaluation and pupils using materials with question emphasis on knowledge. (2) Pupils receiving analysis and evaluation type questions had significantly higher scores in social studies achievement than did pupils receiving knowledge type questions.

Address: Francis Hunkins
Assistant Professor
College of Education
University of Washington
Seattle, Washington 98105

Hunkins, Francis P. Bloom's Taxonomy as a test construction guide. Ideas Educational, The Kent State University School, Spring, 1966, 4:2, 13-16.

The Taxonomy has been suggested as a guide for the development of behavioral objectives and for designing test items consistent with these objectives. The utilization of the Taxonomy is discussed in reference to the construction of multiple choice test items. It is pointed out that some of the categories of the Taxonomy (and not necessarily the highest levels) present some unique difficulties in writing of test items.

Address: Same as page before.

Irwin, Claire & Reitz, William. Functional competencies of undergraduate students in the humanities. Scientia Paedagogica Experimentalis, A. Clausse Publications, Ghent, Belguim, May, 1967, Vol. III, (1), 143-177.

The study was designed to investigate the "functional residue" (p. 144) of the humanities in the experiences of undergraduate college students as evidenced by a critical incident measurement technique. Students' responses were classified according to the Taxonomy processes they represented. The cognitive structure of humanities content was described both a-priori and on the basis of responses. Relationships between types of responses and certain characteristics of the respondents were also investigated using chi-square techniques. A general conclusion was that more attention should be given to development of skills in the upper taxonomic categories in the college curriculum.

Address: Claire Irwin
369 Ed. Bldg.
College of Education
Wayne State University
Detroit, Michigan 48202

Address: William Reitz
371 Ed. Bldg.
College of Education
Wayne State University
Detroit, Michigan 48202

Jarolimek, John. The Taxonomy: guide to differentiating instruction. Social Education, 1962, 26, 445-447.

The Taxonomy is suggested as a model in planning for differentiating instruction in elementary social studies. The teacher can prepare the various categories in chart form to assist in (a) the planning of a unit; (b) the specification of objectives; (c) the diagnosis of student weaknesses; (d) the planning of appropriate learning activities; and (e) the presentation of a highly diversified attack on the study of problems.

Address: Unknown.

Johnson, Stuart R. Relationships among cognitive and affective outcomes of instruction. Unpublished doctoral dissertation, University of California, Los Angeles, 1966.

The purpose of this study was to answer two questions: (1) What relationships exist between cognitive and affective outcomes of instruction? and (2) Are cognitive tasks, arranged by Taxonomy level, differentiable and hierarchically related? An instrument was developed consisting of forty cognitive items representing the first four levels of the cognitive Taxonomy with an affective response scale attached to each item. The study revealed only a small relationship between cognitive achievement and enjoyment of the cognitive task. Only weak support was provided for the hierarchical nature of the cognitive Taxonomy.

Address: Stuart R. Johnson
Program Administrator
Program of the Education of Teachers
Moore Hall 320
University of California
Los Angeles, California 90024

Kellogg, Ralph E., Chairman, San Diego County Secondary Curriculum Council. An American History Test Bank. October, 1964.

A collection of American History test questions was put together by the committee to demonstrate how student achievement might be evaluated at several cognitive levels. The paper is intended as a model and working paper for teachers in the San Diego County.

Address: Ralph E. Kellogg
Director of Curriculum Coordination
San Diego County
Department of Education
6401 Linda Vista Road
San Diego, California 92111

Kilpatrick, Jeremy. Cognitive theory and the SMSG program. Journal of Research in Science Teaching, 1964, 2:3, 247-251.

An interim report is presented on the use of the Taxonomy in devising mathematics tests for all cognitive levels in grades K-12. The tests will be further developed and used for assessing math abilities and cognitive styles of attacking problems as part of the National Longitudinal Study of Mathematical Abilities.

Address: Jeremy Kilpatrick
Research Assistant
Stanford University
Stanford, California 94305

Klein, Minnie Frances. Evaluation of instruction: measurement of cognitive behavior as defined by the "Taxonomy of Educational Objectives." Unpublished doctoral dissertation, University of California, Los Angeles, 1965.

Validation of the Taxonomy with 7-9 year-olds was attempted. Objectives and corresponding test items were developed. Each item was classified as to which of the 21 Taxonomy behaviors it required. Students were then tested after a semesters work. Content validity internal consistency reliability, and item discriminations were established. It was concluded that not all of the items were valid. Only some of the behaviors could be elicited and detected in the subjects. It was suggested that revisions be made in the Taxonomy, but that it could be a valuable tool as is.

Address: Minnie Frances Klein
Research Educationist
University of California
Los Angeles, California 90024

Klinchman, Evelyn. The BSCS grid for test analysis. BSCS Newsletter 19, The Biological Sciences Curriculum Study, Boulder, 1964, 17-21.

The BSCS adaptation of the Taxonomy, for examination of tests to determine if the tests actually incorporate BSCS aims, is presented. Two BSCS tests and the Cooperative Biology Test are analyzed. A difficulty encountered was that of classifying test items when the relevent prior learning experiences of the students is unknown.

Address: Evelyn Klinchman
San Francisco College for Women
San Francisco, California 94118

Krathwohl, David R. The "Taxonomy of Educational Objectives" - its use in curriculum building. In C. M. Lindvall (ed.) Defining Educational Objectives. Pittsburgh, University of Pittsburgh Press, 1964.

The value of the Taxonomy in curriculum construction is discussed. Major uses include: (a) It provides a basis for working with objectives with a specificity and a precision that is not generally typical of such statements. (b) This specificity in the description of student behavior makes it easier to choose appropriate learning experiences and evaluation instruments. (c) It provides a range of possible outcomes that may suggest additional goals that might be included in a curriculum. (d) It provides for a comparison of objectives from curriculum to curriculum. (e) It might suggest a hierarchy of learning experiences. (f) It provides a structure for analyzing test items (both standardized and teacher-made) for comparison with curriculum objectives.

Address: David R. Krathwohl, Dean
School of Education
Syracuse University
Syracuse, New York 13210

Krathwohl, David R. Stating objectives appropriately for program, for curriculum, and for instructional materials development. Journal of Teacher Education, 1965, 83-92.

The use of educational objectives at several levels of detail in the educational process is discussed. The Taxonomy is described as a framework which can facilitate the development and analysis of objectives at the intermediate level. The Taxonomy is a relatively concise model for the analysis of objectives; it provides a panorama of objectives to be explored; it provides a basis for precise comparison; and it may suggest a readiness relationship existing between those objectives lower in the hierarchy and those higher.

Address: Same as above.

Kropp, R. P., Stoker, H. W., & Bashaw, W. L. The validation of the "Taxonomy of Educational Objectives." Journal of Experimental Education, Spring, 1966, 34:69-76.

Evidence concerning the validity of the constructs underlying the construction of the Taxonomy is scarce. The major problems that may be encountered in an attempt to validate the Taxonomy are discussed in order to provide an investigator with some insight into the theoretical and practical problems.

a. The choice of a response measure is a critical problem. A process response measure requires detecting whether or not the students use the intended process, whereas a product response measure requires detecting whether or not the student selects the keyed response.

b. The test content and format are the two major factors to be considered when choosing the conditions under which the response measure will be collected.

c. Ambiguity of the Knowledge category of the Taxonomy may indicate that this category is two-dimensional. A careful analysis of this area should precede any validation study.

d. Statistical difficulty created by the hierarchical nature of the Taxonomy demands the selection of appropriate test construction methodology and perhaps the development of new statistical models.

Several studies which would relate scores on Taxonomy type tests to certain criterion measures are suggested.

Address: Russell Kropp
Director
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Florida State University
Tallahassee, Florida 32306

Address: Howard Stoker
Department of Educational Research and Testing
Florida State University
Tallahassee, Florida 32306

Address: W. L. Bashaw
Assistant Professor
The University of Georgia
Athens, Georgia 30601

Kropp, Russell P., Stoker, Howard W.,& Bashaw, W. Louis. The construction and validation of tests of the cognitive processes as described in the "Taxonomy of Educational Objectives." Cooperative Research Project No. 2117. Institute of Human Learning and Department of Educational Research and Testing, Florida State University, 1966.

A three-year long series of studies designed to explore the construct validity of the Taxonomy is reported. The three questions under consideration were the following:

1. Can empirical evidence be found to support or refute the imputed hierarchical structure?
2. Can empirical evidence be found to support or refute the imputed generality of the several cognitive processes?
3. Can each level of the structure be explained by more elemental cognitive aptitudes, and, if so, do the combinations or numbers of them change systematically from one major level to the next?

The hypothesis of inverse relationships between mean performance and taxonomic level was generally supported; the data supported the imputed hierarchical structure of the Taxonomy. The hypothesis of the generality of process was not clearly supported; the data suggest that the specific test score being analyzed is determined by highly complex interaction of content and process. Investigation of the third question revealed the obvious need for more refined analytic techniques and data from more refined taxonomy-type tests.

Address: Same as page before.

Lawrence, Gordon D. Analysis of teacher-made tests in social studies according to the "Taxonomy of Educational Objectives." (Clarmontiana Collection) On file at Honnold Library of the Claremont Colleges, Claremont, California, 1963.

Tests and final examinations in social studies subjects were collected from 63 high schools in Southern California. 4562 items from 74 randomly selected tests were classified according to the Taxonomy subcategories. The data were analyzed with respect to four subject fields: Geography, American History, World History and U. S. Government. Resultant data indicate (1) Approximately 98% of the items were classified in category 1.00, Knowledge; and 75% of the total items fell in one subcategory of Knowledge: Knowledge of Specific Facts. (2) The 2.3% of the items which fell above category 1.00 were classified in only two of the upper five categories: 2.00, Comprehension (2.0%) and 3.00, Application (0.3%). (3) The four subject fields had a slightly different pattern of distribution of items. Geography items fell almost entirely in the first three subcategories, which deal with knowledge of specifics--and of conventions such as map symbols. In American History, and somewhat in World History, more emphasis is placed on Knowledge of Trends and Sequences and Knowledge of Principles and Generalizations. U. S. Government items were more widely spread throughout the Knowledge category and had a higher percentage (4.6%) in the upper categories than did the other subject fields. World History tests had nearly as large a concentration of items in 1.12 as did Geography tests.

Address: Gordon D. Lawrence
Claremont Graduate School
and University Center
Claremont, California 91711

Lessinger, Leon M. Test building and test banks through the use of the "Taxonomy of Educational Objectives." California Journal of Educational Research, 1963, 14 (5), 195-201.

The Taxonomy can be utilized to upgrade classroom test construction. Teachers in the Grossmont Union High School District are instructed in the use of the Taxonomy and, subsequently, use the categories to aid in construction and revision of test questions. A by-product of this approach has been the collection of 566 carefully prepared geography test items. Similar test banks are being prepared in English, Social Studies, foreign languages and math.

Address: Unknown.

Lombard, John W. Preparing better classroom tests. The Science Teacher, 1965, 33-38.

The construction of better classroom tests may be realized using the Taxonomy as a functional guide. General types of science questions which test the six categories of cognitive objectives are suggested as prototypes for many specific items in different subject-matter areas.

The distinction between the categories of the Taxonomy is not crucial since the purpose of the outline is to help in avoiding undue emphasis on certain categories. Also, the difficulty of an item is not necessarily related to its classification. There is a spread of difficulty levels within each category.

Address: John W. Lombard
Science Research Associates, Inc.
259 East Erie Street
Chicago, Illinois 50511

Mau, Helen Elizabeth D. An investigation of cognitive objectives for college undergraduate home management programs. Unpublished doctoral dissertation, Columbia University, 1965.

A procedure which uses the Taxonomy for the development of cognitive objectives for undergraduate home management courses is described. A list of fifty objectives, each adapted from Taxonomy statements, was presented as a rating sheet to 279 undergraduate home management professors. Analysis of the results indicated that seventeen of the 50 objectives were rated essential by a majority of the sample. Application objectives were rated as the most essential class however the Knowledge class rated on the average more essential than all the other classes combined. A set of eighteen cognitive objectives for undergraduate home management courses was formulated by revising the statement of highest ranking essential objectives.

Address: Helen Elizabeth Dickin Mau
Columbia University
New York, New York 10027

McGuire, Christine. The process approach to evaluation of medical curricula: theory and practice. Paper presented at the Conference on Medical Education sponsored by the South African College of Physicians, Surgeons and Gynecologists and the Medical Association of South Africa, Durban, South Africa, July, 1964.

The Taxonomy of Intellectual Processes is described and discussed as a tool in the evaluation of Medical Curricula. New approaches in both individual and program assessment at several levels of medical education are suggested. (See other articles by McGuire for details of the process approach and results of research studies).

Address: Christine McGuire
Office of Research in
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Chicago, Illinois 60611

McGuire, Christine. A process approach to the construction and analysis of medical examinations. The Journal of Medical Education, 1963, 38, (7), 556-563.

Process approach is defined as the description of an examination in terms of required intellectual activity of the examinee. An exploratory investigation of process analysis applied to the evaluation of medical education programs suggests (a) that certifying examinations currently employed measure chiefly recall of isolated information (b) that reliable examinations of more complex intellectual processes can be designed and (c) that varied patterns of student behaviors are revealed in examinations constructed by the process approach.

Address: Same as above.

McGuire, Christine. Research in the process approach to the construction and to analysis of medical examinations. National Council on Measurement in Education Yearbook, 1963, 20, 7-16.

The following adaptation of the Taxonomy is used to examine the reproducibility and significance of process analysis of medical examinations:

TAXONOMY OF INTELLECTUAL PROCESSES

1. Items testing predominantly the RECALL of isolated information.
2. Items testing the RECOGNITION OF MEANING. (Comprehension)
3. Items requiring the student to SELECT A RELEVANT GENERALIZATION for explaining specific phenomena.
4. Items requiring the student to make SIMPLE INTERPRETATIONS OF DATA.
5. Items requiring the student to APPLY PRINCIPLES to situations of a FAMILIAR TYPE.
6. Items requiring the student to APPLY PRINCIPLES to situations of an UNFAMILIAR TYPE.
7. Items requiring the EVALUATION (including analysis) of a TOTAL SITUATION.
8. Items requiring SYNTHESIS of data into an original and meaningful whole.

Three independent raters, classifying each question in the 1961 National Board Examinations in their specialty, agreed unanimously on 61 percent of 683 items rated. Rater consensus was achieved on the 93% of the items on which two or more raters agreed.

In order to achieve better congruence with the objectives of medical education the following revision of the original Taxonomy of Intellectual Processes is suggested:

1.0 Knowledge
2.0 Generalization
3.0 Problem Solving of a Familiar Type
4.0 Problem Solving of an Unfamiliar Type
5.0 Evaluation
6.0 Synthesis

Conclusions include: (a) process analysis yields reproducible results when applied to medical examinations; (b) medical examinations can reliably test the complex intellectual processes, and (c) medical examinations constructed according to process specifications reveal behavior patterns which tend to support the basic hypothesis in terms of which the Taxonomy has been developed.

Address: Same as page before.

Milholland, J. E. Measuring cognitive abilities. In McKeachie, W. J., Isaacson, R. L., & Milholland, J. E. Research on the Characteristics of Effective College Teaching. Ann Arbor, University of Michigan, 1964.

The Committee on Criterion for the First Course of the Division in Teaching of the American Psychological Association has utilized the Taxonomy in the generation of objectives and in the classification of items for a Criterion Test. Subtests which were designed to measure different types of objectives were developed in an attempt to identify differential patterns of achievement. A factor analysis of the subtest data provided little evidence that the subtest socres represent the objectives they were designed to measure.

Address: John Milholland
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University of Michigan
Ann Arbor, Michigan 48104

Miller, Alice T. Levels of cognitive behavior measured in a controlled teaching situation. Unpublished masters thesis, Cornell University, 1965.

The cumulative hypothesis of the Taxonomy is tested using the Guttman simplex analysis. Approximately 100 students were tested with items representing the first three levels of the Taxonomy. The correlation matrices yield the general pattern of a simplex. The pattern of the regression weights also is consistent with that expectant for the simplex model for the first three levels of the Taxonomy in basic physical and biological sciences.

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Pfeiffer, Isobel & Hunkins, Francis P. Bloom's Taxonomy: A stimulus to better teaching. Ideas Educational, The Kent State University School, Spring, 1965, 3:2, 11-17.

Two studies which illustrate the usefulness of the Taxonomy in analyzing classroom questions are described. The results of these studies point up the need for teachers to analyze test questions for the following reasons: (1) So that proper emphasis is given to all cognitive functions. (2) So that the test will be highly related to the cognitive function the teacher hopes to encourage. (3) So that the teacher realizes that more stimulating questioning is demanded for achieving high quality in the educational process.

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Address: Francis Hunkins
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Pfeiffer, Isobel, & Davis, O. L. Jr. Teacher-made examinations: what kinds of thinking do they demand? Bulletin of the National Association of Secondary School Principals, September, 1965, 49:1-10.

The taxonomic classification of test items in the semester examinations of 9th grade geachers was studied. Percentage of items in each of the six major categories were compared across courses, ability group levels, and programs of study. In all cases the highest percentage of questions fell into the Knowledge category. Second highest was Application. Very few questions were classified into the upper three categories, and these were found primarily in some English courses. It was suggested that teachers should be aware of which cognitive processes they are emphasizing in their test questions, and that there should be more emphasis on the higher objectives for all students in all courses. Also, a study should be made of teaching emphases; Are they the same as those of the examination questions?

Address: Pfeiffer - same as above.

Address: O. L. Davis, Jr., Associate Professor
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Pfeiffer, Isobel L. Teaching in ability grouped English classes: a study of verbal interaction and cognitive goals. Unpublished doctoral dissertation, Kent State University, Kent, Ohio, 1966.

Five teachers who each taught classes of two different ability levels were used as subjects in this study. Teachers were interviewed to obtain estimates of their emphases on different cognitive goals. Teacher-made tests were then analyzed according to cognitive goals inferred by the test items, using the Taxonomy. Findings include the following:

1) Teachers emphasized less complex skills in lower ability classes.
2) Test items also revealed differentiation of cognitive goals for different ability classes.
3) Teachers generally indicated they felt one pattern of cognitive goals was important but tested for another.

Address: Same as page before.

Popham, W. J., & Baker, Eva L. Curriculum principles for prospective teachers. Teacher Education Quarterly, 1965, 22, 38-41.

Two groups of prospective secondary school teachers were exposed to different approaches to principles of curriculum construction. One group (1) studied a five point rationale suggested by Tyler for selecting instructional objectives; the other group (2) studied principles based on the Taxonomy. One prediction made by the investigators was that group 2 would select a greater proportion of objectives classified at higher levels of the Taxonomy. The data did not substantiate this prediction. The study in general indicated that the brief exposure to certain curriculum principles did result in some differences in the responses of the two groups.

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Address: Eva L. Baker
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Romberg, Thomas, & Kilpatrick, Jeremy. Preliminary study on evaluation in mathematics education. Leland Stanford Junior University 1966. (mimeographed report)

A seminar group listed objectives of mathematics education for grades k-12 and wrote sample test questions to illustrate the various topics in the curriculum. The first step involved the identification of basic mathematics topics pupils are expected to master at each grade level. The topics were then classified according to the Taxonomy categories. A set of 50 test items classified according to content and behavioral skills are presented to illustrate the various levels of the Taxonomy by topic in the curriculum.

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Address: Jeremy Kilpatrick
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Stanford University
Stanford, California 94305

Romberg, Thomas A. The development of mathematics achievement tests for the national longitudinal study of mathematical abilities. Leland Stanford Junior University, 1966. (mimeographed report)

Content validity was a concern in the development of mathematics achievement tests. Units of subject matter were identified and the behaviors included in each unit were classified using the Taxonomy as a starting point. The resultant matrix of mathematical behaviors served as a table of specification for test construction procedures.

Address: Same as above.

Sanders, Norris. Classroom Questions: What Kinds? Harper and Row, 1967.

(Abstract to be included at a later date).

Address: Norris Sanders
Manitowac Public Schools
Manitowac, Wisconsin 54220

Scannell, D. P. & Stellwagen, W. R. Teaching and testing for degrees of understanding. California Journal of Instructional Improvement, 1960, 3, (1).

The Taxonomy was used to classify both educational objectives and test items. Objectives and final examinations were collected from high school chemistry teachers in order to compare the relationship between the statement and the measurement of the objectives. Findings include:

1. Over 50 percent of the objectives and 60 percent of the test items related to accumulation of knowledge.
2. Very seldom were students required to exhibit complex cognitive skills (understanding of various degrees) on final examinations.
3. There was seldom a direct relationship between the levels of stated goals and the levels of required examination behavior.

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Address: Walter R. Stellwagen
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Science Research Associates
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Schmadel, Elnora, The relationship of creative thinking abilities to school achievement. Unpublished doctoral dissertation, University of Southern California, 1960.

Tests of evaluation and synthesis, as defined by the Taxonomy were constructed. Low correlation between the scores on these tests and other achievement measures are reported.

Address: Unknown.

Scott, Harry V. Cognitive analysis of a curriculum: an application of "Taxonomy of Educational Objectives: Handbook I: Cognitive Domain" to "Science--a Process Approach." Unpublished doctoral dissertation, Teachers College, Columbia University, 1966.

An introspective analysis of the lessons in Science--A Process Approach is reported. An attempt is also made to establish categories based on the curriculum.

(Abstract to be included at a later date).

Address: Harry V. Scott
West Virginia State College
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Scriven, Michael. The methodology of evaluation. Perspectives of Curriculum Evaluation, American Educational Research Association Monograph Series on Curriculum Evaluation, Number 1, Chicago, 1967.

Criteria which should be used in evaluating a teaching instrument are specified in detail using a modified structure of the Taxonomy. (Cognitive, Affective, and Motor variables). The Knowledge and Understanding (Comprehension) categories are restructured in an attempt to reduce overlap of factors in the Taxonomy. Conceptual description of educational objectives as well as a manifestation dimension of criterial variables are presented. Examples pertinent to the cognitive domain follow:

11.1 Conceptual Description of Educational Objectives

1. Knowledge, of
   a. Items of specific information including definitions of terms in the field.
   b. Sequences or patterns of items of information including rules, procedures or classifications for handling or evaluating items of information. (We are here talking about mere knowledge of the rule and not the capacity to apply it).

(cont'd on next page)

2. Comprehension or Understanding, of

   a. Internal relationships in the field, the way in which some of the knowledge claims are consequences of others and imply yet others, the way in which the terminology applies within the field; in short what might be called understanding of the intrafield syntax of the field or subfield.
   b. Interfield relations, i.e. relations between the knowledge claims in this field and those in other fields; what we might call the interfield syntax.
   c. Application of the field or the rules, procedures and concepts of the field to appropriate examples, where the field is one that has such applications; this might be called the semantics of the field.

11.2 Manifestation Dimension of Criterial Variables.

1. Knowledge (in the sense described above) is evinced by
   a. Recital skills.
   b. Discrimination skills.
   c. Completion skills.
   d. Labeling skills.

   Note: Where immediate performance changes are not discernible, there may still be some subliminal capacity, manifesting itself in a reduction in re-learning or in future learning to criterion.
2. Comprehension is manifested on some of the above types of performance and also on
   a. Analyzing skills, including laboratory analysis skills, other than motor, as well as the verbal analytic skills, exhibited in criticism, precis, etc.
   b. Synthesizing skills.
   c. Evaluation skills.
   d. Problem-solving skills (speed-dependent and speed-independent).

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Sliepcevich, Elena M., director, School Health Education Study. Health education: a conceptual approach to curriculum design. St. Paul, Minnesota, 3M Company Educational Services, April, 1967

A conceptual model for Health Education (grades K-12) includes a classification of goals into three domains - cognitive, affective, and action. The classifications for the cognitive and affective domains were taken from both the Bloom and Krathwohl Taxonomies.

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Smith, Richard B. & Paterson, John. A measurement problem in action research. Unpublished manuscript, Purdue University, 1965.

An attempt is made to varify a simple-to-complex continuum at the knowledge and comprehension levels of the Taxonomy. A logical progression from "knowledge of terminology" to "extrapolation" from a principle involving the use of the specific term was hypothesized. The results do not support the hypothesis but indicate the lack of relationship between items supposedly dealing with levels of understanding of the same principle.

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Lafayette, Indiana 47907

Address: John Paterson
University of West Virginia
Morgantown, West Virginia 26505

Smith, Richard B. An analysis of scalability of the 'knowledge' and 'comprehension' levels of the "Taxonomy of Educational Objectives: Cognitive Domain." Paper read at the meeting of the National Council on Measurement in Education, 1965.

The Knowledge and Comprehension categories of the Taxonomy were used as the basis for generating multiple choice items dealing with five basic educational psychology concepts. Item analysis indicates a general but not perfect scaling of difficulty levels as one proceeds through the knowledge category. Examination of the intercorrelations of the sub-classes of the Knowledge and Comprehension categories failed to yield a hypothesized simplex.

Address: Same as page before.

Smith, Richard B. An attempt at constructing scalable sets of test items in the physical sciences. Paper presented at the annual meeting of the National Council on Measurement in Education, February, 1967.

The reputed hierarchical categories of the Taxonomy are utilized in an attempt to develop scalable sets of test items in the physical sciences. Item sets consist of seven or eight multiple choice items which attempt to build upon one another so that each succeeding item requires all the knowledge and processes of the preceeding item plus a little more. Sample sets of items are presented and discussed in reference to the above criteria. Problems were encountered in trying to construct multiple choice items for the Application, Analysis, and Synthesis categories.

Address: Same as page before.

Stanley, Julian C. & Bolton, Dale L. A review of Bloom's "Taxonomy of Educational Objectives" and J. R. Gerberich's "Specimen Objective Test Items, A Guide to Achievement Test Construction." Educational and Psychological Measurement, 1957, 17:4, 631-634.

Empirical data is presented concerning (1) the ease or difficulty with which test items can be classified according to the Taxonomy and (2) the levels into which such items fall. Eight graduate students in a class which had studied the Taxonomy for four weeks were asked to classify Gerberich's test items according to the subcategories of the Taxonomy. Results indicate that on one-half of the items, five or more classifiers indicated perfect agreement. Taking into consideration that each item had to be classified into an exact subcategory, the results indicate that the Taxonomy can be used with considerable precision.

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Stoker, H. W. & Kropp, R. P. Measurement of cognitive processes. Journal of Educational Measurement, 1964, 1, (1), 39-42.

Two questions are investigated: Can judges agree in the cognitive process which a test item is intended to measure? Can the imputed hierarchical structure of the Taxonomy be empirically validated? Interjudge agreement was found with respect to the classification of test items in the intended category. General support for the hierarchical structure of the Taxonomy is suggested by the data, however, a hypothesized factor structure was not supported by various factor matrices.

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Florida State University
Tallahassee, Florida 32306

Stoker, Howard. An emerging trend in achievement testing. Florida Journal of Educational Research, January, 1965, Vol. VII, No. 1.

A research project designed as a validation study of the Taxonomy is described. Two major questions investigated were (1) Can judges agree on the classification of test items into the Taxonomy categories? (2) Can empirical evidence be obtained to support the theoretical hierarchical structure of the Taxonomy.

Test items from two standardized tests (Reading comprehension and Arithmetic computation) were classified by a panel of judges. Results indicate that raters do tend to agree and do tend to classify items congruent with the behaviors the items were intended to evoke.

Experimental tests generated using the Taxonomy categories were administered to 1,000 students in grades 9-12. Results supported the hypothesized order of mean category scores thus providing general evidence for the imputed hierarchical structure of the Taxonomy.

Address: Same as page before.

Stevens, Godfrey D. Taxonomy in special education for children with body disorders. Department of Special Education and Rehabilitation. University of Pittsburgh, Pittsburgh, Pennsylvania.

A broad outline of a tentative Taxonomy suited to the central purpose of special education is presented. The outline, which is decimally coded, is clarified by a discussion of each separate element.

Suggestions for using the Taxonomy and suggestions which may lead to studies designed to refine the taxonomic structure are presented.

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Turner, M. & Dunn, S. S. A.C.E.R. Prematriculation Physics Examination, Report No. 2. Australian Council for Educational Research, Hawthorn, Victoria, Australia, 1965.

Research involving the A.C.E.R. Prematriculation Physics Examination included an analysis according to three components of the test--knowledge, application and understanding. Results indicate that (a) knowledge items were less reliable, as a group, than the other type items; and (b) various groups of subjects showed greatest relative differences on understanding type items and smallest differences on knowledge type items. This latter result was a notable characteristic of the female vs. male variable.

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Australia

Tyler, Louise L., & Okumu, Laura J. A beginning step: a system for analyzing courses in teacher education. Journal of Teacher Education, 1965, 16, (4), 438-444.

A study of a teach education program utilized the Taxonomy to classify course materials and examinations. Findings include: (a)a noticeable discrepancy between course descriptions and actual behaviors required; (b) a considerable emphasis upon knowledge type behaviors; and (c) a lack of attention given to developing certain important cognitive skills. The Taxonomy provided a useful structure for looking at course behaviors.

Address: Louise L. Tyler
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Los Angeles, California 90024

Address: Laura J. Okumu - address unknown.

Wilhoyte, Robert Lee. Problems of meaning and reference in Bloom's Taxonomy: Cognitive Domain. Unpublished doctoral dissertation, Indiana University, 1965.

The organization and internal structure of the Taxonomy was examined. An attempt was made to resolve the dilemma of whether the Taxonomy's logical arrangement restricts the very objectives from which it is supposed to be generated. It was concluded that the empirical ground of the Taxonomy is weak since the data to be classified are teacher intended student behaviors while the class and sub-class terms refer to actual student performance. However, if teacher intentions are based on actual events rather than intuitions and personal preferences, then the terms are less prescriptive. Finally, if significance is retained and formulated as definiens of verbal definitions, then the abstracted Taxonomy is verifiable and efficacious.

Address: Unknown.

Wood, Jean Marie. A survey of objectives for teacher education. Prepared for the Commission on Teacher Education, Association for Supervision and Curriculum Development. San Bernardino City School System, San Bernardino, California, 1960.

The Taxonomy was used to classify educational objectives of teacher training institutions as stated in the 1959 catalogs of colleges and universities accredited by the National Council of Accreditation of Teacher Education. The distribution of objectives in each major category is presented with 200 of 369 objectives falling in the Knowledge category.

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Zinn, Karl L. Validation of a differential test of cognitive objectives of the first course in psychology. Unpublished doctoral dissertation, University of Michigan, 1964.

The Taxonomy is evaluated using a test of the achievement of objectives taken from the Taxonomy. Primary concern is with the empirical differentiation of achievement measures. Three proposed requirements for the empirical validation of a differential achievement test include: (a) the reliable variance should be sufficiently distinct, (b) the different objectives should be measured by the same testing method or item type, and (c) measures differentiable within on testing method should be distinct from measures of aptitudes unchanged by instruction.

Data from two semesters of introductory psychology indicate that the Taxonomy was not differentiable in the test behaviors of students. Conservative interpretation of the results of such differential tests is suggested.

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